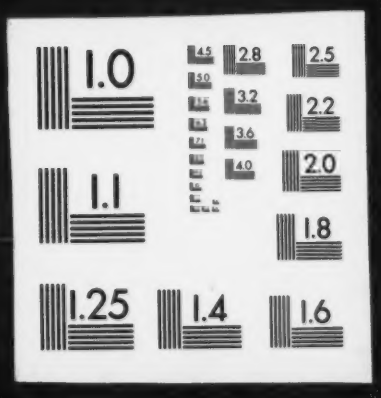
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Apprenticeship and Industry Training

Sheet Metal Worker

Apprenticeship Course Outline

1110 (2010)

Government of Alberta

Apprenticeship and Industry Training

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Sheet Metal Worker
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Apprenticeship

Apprenticeship is post-secondary education with a difference. Apprenticeship begins with finding an employer. Employers hire apprentices, pay their wages and provide on-the-job training and work experience. Approximately 80 per cent of an apprentice's time is spent on the job under the supervision of a certified journeyperson or qualified tradesperson. The other 20 per cent involves technical training provided at, or through, a post-secondary institution – usually a college or technical institute.

To become certified journeypersons, apprentices must learn theory and skills, and they must pass examinations. Requirements for certification—including the content and delivery of technical training—are developed and updated by the Alberta Apprenticeship and Industry Training Board on the recommendation of the Sheet Metal Worker Provincial Apprenticeship Committee.

The graduate of the Sheet Metal Worker apprenticeship training is a certified journeyperson who will be able:

- supervise, train and coach apprentices.
- use and maintain hand and power tools to the standards of competency and safety required in the trade.
- apply the correct principles of sheet metal pattern development using triangulation, parallel line, and radial line development.
- read and use blueprints and specifications to estimate, fabricate and install sheet metal items.
- fabricate and install, safely and efficiently, fume and dust exhaust systems, ventilation, heating and air-conditioning systems and equipment for restaurants, hospitals, dairies, breweries, etc.
- know, and be able to apply their knowledge of the advantages and limitations of various types of sheet metal used in the trade including non-metallic materials such as plastics.
- know, and be able to apply their knowledge of the installation, and service of HVAC systems in accordance with local, provincial and national standards for the industry.
- co-ordinate sheet metal work with other trades on the job site.
- do all sheet metal related tasks expected of a certified journeyperson.

Apprenticeship and Industry Training System

Industry-Driven

Alberta's apprenticeship and industry training system is an industry-driven system that ensures a highly skilled, internationally competitive workforce in more than 50 designated trades and occupations. This workforce supports the economic progress of Alberta and its competitive role in the global market. Industry (employers and employees) establishes training and certification standards and provides direction to the system through an industry committee network and the Alberta Apprenticeship and Industry Training Board. The Alberta government provides the legislative framework and administrative support for the apprenticeship and industry training system.

Alberta Apprenticeship and Industry Training Board

The Alberta Apprenticeship and Industry Training Board provides a leadership role in developing Alberta's highly skilled and trained workforce. The board's primary responsibility is to establish the standards and requirements for training and certification in programs under the Apprenticeship and Industry Training Act. The board also provides advice to the Minister of Advanced Education and Technology on the needs of Alberta's labour market for skilled and trained workers, and the designation of trades and occupations.

The thirteen-member board consists of a chair, eight members representing trades and four members representing other industries. There are equal numbers of employer and employee representatives.

Industry Committee Network

Alberta's apprenticeship and industry training system relies on a network of industry committees, including local and provincial apprenticeship committees in the designated trades, and occupational committees in the designated occupations. The network also includes other committees such as provisional committees that are established before the designation of a new trade or occupation comes into effect. All trade committees are composed of equal numbers of employer and employee representatives. The industry committee network is the foundation of Alberta's apprenticeship and industry training system.

Local Apprenticeship Committees (LAC)

Wherever there is activity in a trade, the Board can set up a local apprenticeship committee. The Board appoints equal numbers of employee and employer representatives for terms of up to three years. The committee appoints a member as presiding officer. Local apprenticeship committees:

- monitor apprenticeship programs and the progress of apprentices in their trade, at the local level
- make recommendations to their trade's provincial apprenticeship committee (PAC) about apprenticeship and certification in their trade
- promote apprenticeship programs and training and the pursuit of careers in their trade
- make recommendations to the Board about the appointment of members to their trade's PAC
- help settle certain kinds of disagreements between apprentices and their employers
- carry out functions assigned by their trade's PAC or the Board

Provincial Apprenticeship Committees (PAC)

The Board establishes a provincial apprenticeship committee for each trade. It appoints an equal number of employer and employee representatives, and, on the PAC's recommendation, a presiding officer - each for a maximum of two terms of up to three years. Most PACs have nine members but can have as many as twenty-one. Provincial apprenticeship committees:

- make recommendations to the board about:
    - standards and requirements for training and certification in their trade
    - courses and examinations in their trade
    - apprenticeship and certification
    - designation of trades and occupations
    - regulations and orders under the Apprenticeship and Industry Training Act
- monitor the activities of local apprenticeship committees in their trade
- determine whether training of various kinds is equivalent to training provided in an apprenticeship program in their trade
- promote apprenticeship programs and training and the pursuit of careers in their trade
- consult with other committees under the Apprenticeship and Industry Training Act about apprenticeship programs, training and certification and facilitate cooperation between different trades and occupations
- consult with organizations, associations and people who have an interest in their trade and with employers and employees in their trade
- may participate in resolving certain disagreements between employers and employees
- carry out functions assigned by the Board

Sheet Metal Worker PAC Members at the time of the PAC's recommendation of the course outline to the Board for approval

Mr. J. Peter Wyatt	Calgary	Presiding Officer
Mr. H. Langejans	Calgary	Employer
Mr. B. Johnson	Red Deer	Employer
Mr. R. Lysons	Sherwood Park	Employer
Mr. D. Weavers	Fort McMurray	Employer
Mr. R. Doerksen	Calgary	Employee
Mr. M. Hofer	Lethbridge	Employee
Mr. T. House	Grande Prairie	Employee

Alberta Government

Alberta Advanced Education and Technology works with industry, employer and employee organizations and technical training providers to:

- facilitate industry's development and maintenance of training and certification standards
- provide registration and counselling services to apprentices and employers
- coordinate technical training in collaboration with training providers
- certify apprentices and others who meet industry standards

Technical Institutes and Colleges

The technical institutes and colleges are key participants in Alberta's apprenticeship and industry training system. They work with the board, industry committees and Alberta Advanced Education and Technology to enhance access and responsiveness to industry needs through the delivery of the technical training component of apprenticeship programs. They develop lesson plans from the course outlines established by industry and provide technical training to apprentices.

Apprenticeship Safety

Safe working procedures and conditions, incident/injury prevention, and the preservation of health are of primary importance in apprenticeship programs in Alberta. These responsibilities are shared and require the joint efforts of government, employers, employees, apprentices and the public. Therefore, it is imperative that all parties are aware of circumstances that may lead to injury or harm.

Safe learning experiences and healthy environments can be created by controlling the variables and behaviours that may contribute to or cause an incident or injury. By practicing a safe and healthy attitude, everyone can enjoy the benefit of an incident and injury free environment.

Alberta Apprenticeship and Industry Training Board Safety Policy

The Alberta Apprenticeship and Industry Training Board fully supports safe learning and working environments and encourages the teaching of proper safety procedures both within trade specific training and in the workplace.

Trade specific safety training is an integral component of technical training, while ongoing or general non-trade specific safety training remains the responsibility of the employer and the employee as required under workplace health and safety legislation.

Workplace Responsibilities

The employer is responsible for:

- training employees and apprentices in the safe use and operation of equipment
- providing and maintaining safety equipment, protective devices and clothing
- enforcing safe working procedures
- providing safeguards for machinery, equipment and tools
- observing all accident prevention regulations

The employee is responsible for:

- working in accordance with the safety regulations pertaining to the job environment
- working in such a way as not to endanger themselves, fellow employees or apprentices

Workplace Health and Safety

A tradesperson is often exposed to more hazards than any other person in the work force and therefore should be familiar with and apply the Occupational Health and Safety Act, Regulations and Code when dealing with personal safety and the special safety rules that apply to all daily tasks.

Workplace Health and Safety (Alberta Employment, Immigration and Industry) conducts periodic inspections of workplaces to ensure that safety regulations for industry are being observed.

Additional information is available at www.worksafely.org

Technical Training

Apprenticeship technical training is delivered by the technical training providers in the public and private post-secondary system throughout Alberta. The technical training providers are committed to delivering the technical training component of Alberta apprenticeship programs in a safe, efficient and effective manner. All technical training providers place great emphasis on safe technical practices that complement safe workplace practices and help to develop a skilled, safe workforce.

The following technical training providers deliver Sheet Metal Worker trade apprenticeship training:

Northern Alberta Institute of Technology Southern Alberta Institute of Technology

Procedures for Recommending Revisions to the Course Outline

Advanced Education and Technology has prepared this course outline in partnership with the Sheet Metal Worker Provincial Apprenticeship Committee.

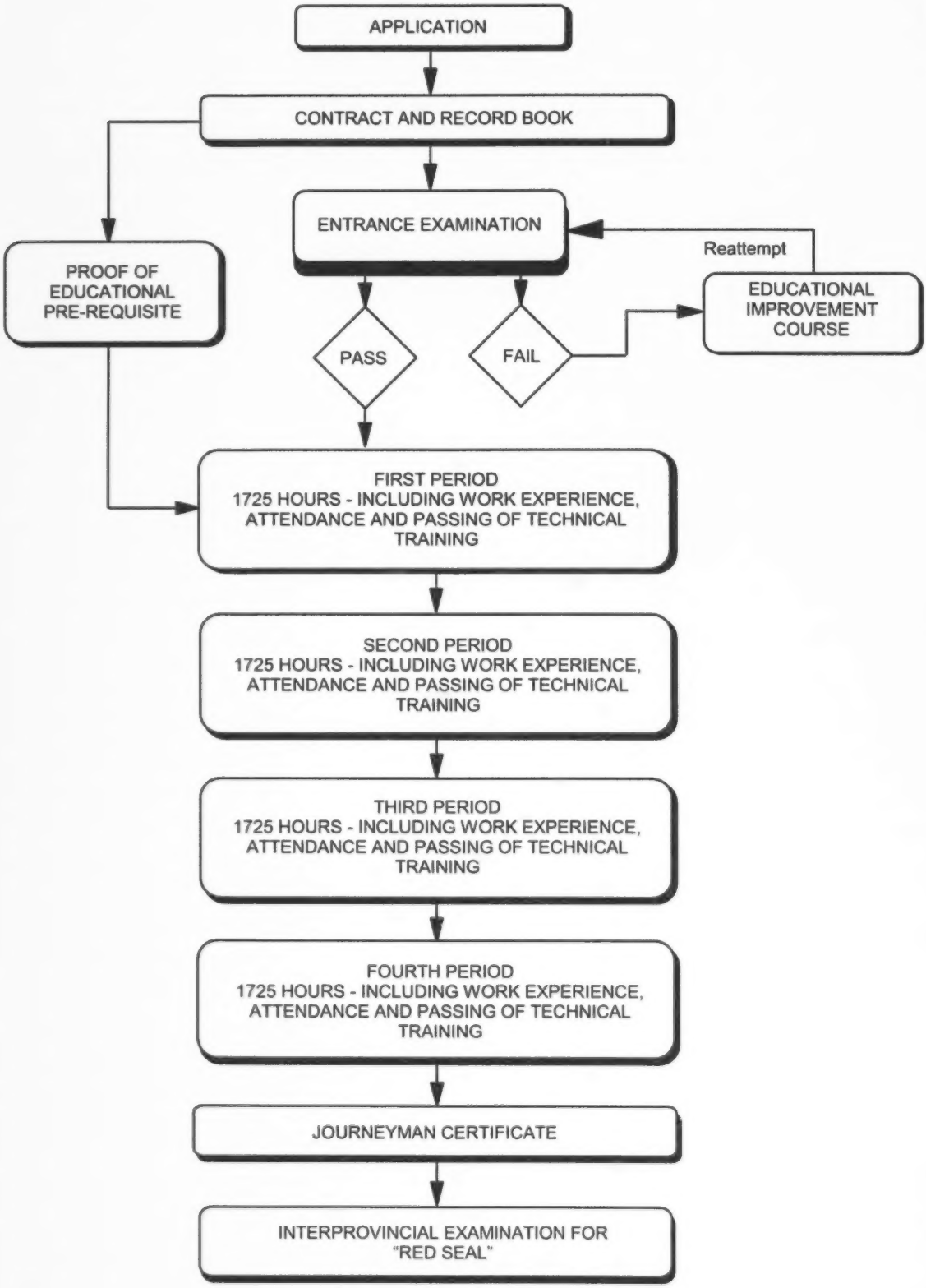
This course outline was approved on December 6, 2009 by the Alberta Apprenticeship and Industry Training Board on a recommendation from the Provincial Apprenticeship Committee. The valuable input provided by representatives of industry and the institutions that provide the technical training is acknowledged.

Any concerned individual or group in the province of Alberta may make recommendations for change by writing to:

Sheet Metal Worker Provincial Apprenticeship Committee
c/o Industry Programs and Standards
Apprenticeship and Industry Training
Advanced Education and Technology
10th floor, Commerce Place
10155 102 Street NW
Edmonton AB T5J 4L5

It is requested that recommendations for change refer to specific areas and state references used. Recommendations for change will be placed on the agenda for regular meetings of the Sheet Metal Worker Provincial Apprenticeship Committee.

Apprenticeship Route toward Certification


APPLICATION
CONTRACT AND RECORD BOOK
ENTRANCE EXAMINATION
Reattempt
PROOF OF EDUCATIONAL PRE-REQUISITE
EDUCATIONAL IMPROVEMENT COURSE
PASS
FAIL
FIRST PERIOD
1725 HOURS - INCLUDING WORK EXPERIENCE, ATTENDANCE AND PASSING OF TECHNICAL TRAINING
SECOND PERIOD
1725 HOURS - INCLUDING WORK EXPERIENCE, ATTENDANCE AND PASSING OF TECHNICAL TRAINING
THIRD PERIOD
1725 HOURS - INCLUDING WORK EXPERIENCE, ATTENDANCE AND PASSING OF TECHNICAL TRAINING
FOURTH PERIOD
1725 HOURS - INCLUDING WORK EXPERIENCE, ATTENDANCE AND PASSING OF TECHNICAL TRAINING
JOURNEYMAN CERTIFICATE
INTERPROVINCIAL EXAMINATION FOR "RED SEAL"

Sheet Metal Worker Training Profile

FIRST PERIOD

(10 Weeks 30 Hours Per Week – Total of 300 Hours)

SECTION ONE

INTRODUCTION TO SHEET METAL THEORY
40 HOURS

A	B	C
Sheet Metal Worker Apprenticeship Program 2 Hours	Workplace Safety 4 Hours	WHMIS 2 Hours
D	**E**	**F**
Ladders, Scaffolds and Lifts 2 Hours	Rigging 3 Hours	Hand Tools 4 Hours
G	**H**	**I**
Bench Machines 4 Hours	Floor and Power Equipment 3 Hours	Explosive Actuated Tools 3 Hours
J	**K**	**L**
Materials 3 Hours	Seams, Fasteners, Sealants and Insulation 2 Hours	Basic Math Concepts 5 Hours
M		
Conversion and Linear Measurement 3 Hours		

SECTION TWO

INTRODUCTION TO PATTERN DEVELOPMENT
50 HOURS

A	B	C
Introduction to Drafting 4 Hours	Basic Geometry 4 Hours	Simple Layout 4 Hours
D	**E**	**F**
Rectangular Elbows 6 Hours	Rectangular Change Elbows / Y-Branches 8 Hours	Ogee Offsets 4 Hours
G	**H**	**I**
Duct Takeoffs 2 Hours	Introductions to Parallel Line Pattern Development 2 Hours	Roof Jacks 4 Hours
J	**K**	**L**
Finials 2 Hours	Round Elbows and Offsets 6 Hours	Introduction to Conical Layout 4 Hours

SECTION THREE

INTRODUCTION TO FABRICATION AND WELDING
150 HOURS

A	B	C
Flat Rectangular Fitting Fabrication 78 Hours	Round Fitting Fabrication 36 Hours	Roof Jack Fabrication 16 Hours
D	**E**	**F**
Joints and Seams 2 Hours	Welding Safety 4 Hours	Welding and Cutting Process 5 Hours
G		
Mild Steel GMAW Welding 9 Hours		

SECTION FOUR

INTRODUCTION TO BLUEPRINT READING / RESIDENTIAL HVAC
60 HOURS

A	B	C
Orthographic Projection 10 Hours	Pictorial Drawings 6 Hours	Blueprint Reading Components 4 Hours
D	**E**	**F**
HVAC Blueprints 6 Hours	HVAC Material Takeoff 10 Hours	Residential HVAC Components 7 Hours
G	**H**	
Residential Heating Systems and Equipment 7 Hours	Residential Installations and Codes 10 Hours	

SECOND PERIOD
(10 Weeks 30 Hours Per Week – Total of 300 Hours)

SECTION ONE

BASIC SHEET METAL THEORY
40 HOURS

A	B	C
Roofing 4 Hours	Introduction to Combustion 5 Hours	Combustion Air Sizing 7 Hours
D	**E**	**F**
Appliance Venting 10 Hours	Temperature, Humidity and Ventilation 5 Hours	Air Filtration, Circulation and Noise 5 Hours
G		
Related Math Skills 4 Hours		

SECTION TWO

BASIC PATTERN DEVELOPMENT
60 HOURS

A	B	C
Leader Heads and Canopies 4 Hours	Pipe Tees 12 Hours	Introduction to Triangulation 4 Hours
D	**E**	**F**
Transition and Twists 6 Hours	Transitional Elbows 8 Hours	Transitional Ogee Offsets 8 Hours
G	**H**	**I**
Transitional Y Branches 6 Hours	Square and Rectangular to Round 8 Hours	Round to Round Reducers 4 Hours

SECTION THREE

BASIC FABRICATION
120 HOURS

A	B	C
Transitional Fitting Fabrication 57 Hours	Conical Projects 12 Hours	Custom Fabrication and Hand Skills 21 Hours
D	**E**	**F**
Tee Fabrication 20 Hours	Fabrication From Plan View 3 Hours	Power Shop Equipment 3 Hours
G		
Soldering 4 Hours		

SECTION FOUR

BASIC BLUEPRINT READING
40 HOURS

A	B	C
Multi Equipment Systems 6 Hours	Multiple Family Blueprint Reading 6 Hours	Commercial Blueprint Structures 8 Hours
D	**E**	**F**
Shop Drawings 6 Hours	Light Commercial Installation Procedures 8 Hours	Smoke and Fire Containment 6 Hours

SECTION FIVE

SYSTEM CONTROLS
40 HOURS

A	B	C
Basic Electricity and Electrical Meters 7 Hours	Standard Furnace Components 7 Hours	Basic Wiring Diagrams 4 Hours
D	**E**	**F**
Furnace Components Diagnostics and Installation 6 Hours	Basic Service 8 Hours	Heating with Alternative Fuels 2 Hours
G		
Gas Piping / Installer Responsibilities 6 Hours		

THIRD PERIOD
(10 weeks 30 Hours per Week – Total of 300 Hours)

SECTION ONE

INTERMEDIATE SHEET METAL THEORY
40 HOURS

A	B	C
Stainless Steel 4 Hours	Heat Loss and Heat Gain 13 Hours	Residential HVAC Design 12 Hours
D	**E**	
Air Flow 6 Hours	Small Commercial Duct Designs 5 Hours	

SECTION TWO

INTERMEDIATE PATTERN DEVELOPMENT
40 HOURS

A	B	C
Multiple Branches 6 Hours	Triangulation From Elevation 7 Hours	Reducing Round Elbows 6 Hours
D	**E**	**F**
Round Reducing Offsets 4 Hours	Round Reducing Y Branches 8 Hours	Truncated Cones 2 Hours
G		
Pipe Tees on Cones 7 Hours		

SECTION THREE

INTERMEDIATE FABRICATION AND WELDING
140 HOURS

A	B	C
Aluminum Fabrication 12 Hours	Stainless Steel Fabrication 12 Hours	Medium Pressure Duct Fabrication 52 Hours
D	**E**	**F**
Introduction to Computerized Layouts and Plasma 12 Hours	SMACNA Specification Fabrication 26 Hours	Gas Tungsten Welding (GTAW) 26 Hours

SECTION FOUR

INTERMEDIATE BLUEPRINT READING
40 HOURS

A	B	C
Multiple Zone Equipment 8 Hours	Duct Construction 9 Hours	Specifications and Schedules 5 Hours
D	**D**	**E**	**F**
Job Takeoffs 8 Hours		Job Supervision 6 Hours	Architectural and Custom Sheet Metal 4 Hours

SECTION FIVE

INTERMEDIATE SYSTEM CONTROLS
40 HOURS

A	B	C
Electronic Ignition 8 Hours	System Controls and Schematics 10 Hours	Furnace Start-Up 4 Hours
D	**E**	
Testing and Troubleshooting 12 Hours	Basic Refrigeration 6 Hours	

FOURTH PERIOD

(10 Weeks 30 Hours per Week – Total of 300 Hours)

SECTION ONE

ADVANCED SHEET METAL THEORY
40 HOURS

A	B	C
Natural Ventilation 4 Hours	Energy Efficient Buildings 4 Hours	Mechanical Air Movement and Control 6 Hours
D	**E**	**F**
Commercial HVAC Systems 6 Hours	Commercial Air Filters and Sound Control 5 Hours	Industrial Exhaust 5 Hours
G	**H**	
Commercial Kitchen Exhaust Systems 6 Hours	Trigonometry 4 Hours	

SECTION TWO

ADVANCED PATTERN DEVELOPMENT
40 HOURS

A	B	C
Oblique Cylinders and Boot Tees 8 Hours	Boots 10 Hours	Conical Tees 4 Hours
D	**E**	**F**
Bull Head Tees 8 Hours	Advanced Radial Lines 8 Hours	Pattern Development Short Cuts 2 Hours

SECTION THREE

ADVANCED FABRICATION AND WELDING
144 HOURS

A	B	C
Cladding and Lagging 12 Hours	Advanced Shop Procedures 70 Hours	Time Sensitive Fabrication 53 Hours
D		
Specialty GMAW Welding 9 Hours		

SECTION FOUR

ADVANCED BLUEPRINT READING AND ESTIMATING
36 HOURS

A	B	C
Industrial Blueprints 8 Hours	Estimating and Pricing 10 Hours	Bidding Procedures 8 Hours
D	**E**	**F**
Workplace Coaching 4 Hours	Advisory Network 2 Hours	Interprovincial Standards 4 Hours

SECTION FIVE

ADVANCED SYSTEM CONTROLS
40 HOURS

A	B	C
Commercial HVAC Equipment 8 Hours	Troubleshooting Commercial HVAC Equipment 10 Hours	Spilt Systems 13 Hours
D		
Air Balancing 9 Hours		

NOTE: The hours stated are for guidance and should be adhered to as closely as possible. However, adjustments must be made for rate of apprentice learning, statutory holidays, registration and examinations for the training establishment and Apprenticeship and Industry Training

FIRST PERIOD TECHNICAL TRAINING
SHEET METAL WORKER TRADE
COURSE OUTLINE

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

SECTION ONE:..... INTRODUCTION TO SHEET METAL THEORY ..... 40 HOURS

A. Sheet Metal Worker Apprenticeship Training Program Orientation ..... 2 Hours

Outcome: ***Describe the apprenticeship system in Alberta and the role played by the various regulatory bodies in the training of sheet metal workers.***

1. Describe the apprenticeship training system in Alberta.
2. Describe the apprenticeship training system for sheet metal workers in Alberta
3. Describe the role of the training institutes in sheet metal worker technical training.

B. Workplace Safety..... 4 Hours

Outcome: ***Apply Occupational Health and Safety regulations and safe work practices.***

1. Interpret Occupational Health and Safety regulations.
2. Describe requirements related to personal protective equipment and safety measures.
3. Describe emergency procedures when dealing with injured employees.
4. Describe potential health hazards.

C. Workplace Hazardous Material Information System (WHMIS)..... 2 Hours

Outcome: ***Apply the requirements of WHMIS to the worksite.***

1. Describe the three key elements of WHMIS.
2. Identify and interpret WHMIS labels and hazard symbols.

D. Ladders, Scaffolds and Lifts ..... 2 Hours

Outcome: ***Use ladders, scaffolds and man lifts.***

1. Describe the use of various types of ladders.
2. Describe the use of various types of scaffolds
3. Describe the use of various types of lifts.
4. Demonstrate the safe use of ladders, scaffolds and lifts.

E. Rigging ..... 3 Hours

Outcome: ***Apply safe rigging and hoisting practices.***

1. Identify ropes and knots.
2. Identify the various materials used in rigging and hoisting.
3. Determine the appropriate materials used for lifting HVAC equipment.

4. Demonstrate hand signals.

F. Hand Tools ..... 4 Hours

Outcome: ***Perform metal working processes using bench machines.***

1. Select and use hand tools for measurement.
2. Select and use hand tools for cutting, notching and punching.
3. Select and use hand tools for forming, bending and shaping.
4. Select and use hand tools for fastening and material removal.

G. Bench Machines ..... 4 Hours

Outcome: ***Perform metal working processes using bench machines.***

1. Select and use rotary machines.
2. Select and use metal punching, shearing and forming bench machines.
3. Select and use stakes and stakeholders.

H. Floor and Power Equipment ..... 3 Hours

Outcome: ***Perform metal working processes using floor and power equipment.***

1. Select and use portable power equipment and accessories.
2. Select and use sheet metal floor machines.
3. Select and use sheet metal powered floor equipment.

I. Explosive Actuated Tools ..... 3 Hours

Outcome: ***Operate explosive actuated tools.***

1. Identify high and low velocity tools.
2. Select power loads and fastening devices.
3. Assess base material suitability and related fastening requirements.
4. Recognize and exercise safety precautions while using explosive tools.
5. Demonstrate tool usage procedures.

J. Materials ..... 3 Hours

Outcome: ***Use various sheet metal materials.***

1. Describe the properties of metals and conditions that affect them.
2. Identify and select ferrous materials.
3. Identify and select non-ferrous materials.
4. Identify and select alternate materials.

K. Seams, Fasteners, Sealants and Insulation ..... 2 Hours

Outcome: ***Use various seams and edges, fasteners, sealants and insulations.***

1. Identify various seams, edges, locks and joints.

2. Identify and select various fasteners.
3. Identify and select various caulking, sealants and insulations.

L. Basic Math Concepts ..... 5 Hours

Outcome: ***Solve basic mathematical problems.***

1. Describe the basic calculator functions and operations.
2. Perform basic math calculations using whole numbers, fractions and decimals.
3. Perform measurement conversions using whole numbers, fractions and decimals.
4. Solve problems using ratio, proportion and percentages.
5. Perform calculations using Pythagoreans Theorem.

M. Conversion and Linear Measurement ..... 3 Hours

Outcome: ***Solve basic conversion and linear mathematical problems.***

1. Convert various measurements into different units.
2. Calculate perimeters, areas and volumes of various shapes.
3. Interpret a micrometer.

SECTION TWO: ..... INTRODUCTION TO PATTERN DEVELOPMENT ..... 50 HOURS

A. Introduction to Drafting ..... 4 Hours

Outcome: ***Use basic drafting equipment.***

1. Define common Pattern Development terms.
2. Identify and use common drafting equipment.
3. Use a scale rule to measure various lines.
4. Identify and draw typical line types.
5. Draw a basic title block and border.

B. Basic Geometry ..... 4 Hours

Outcome: ***Draw basic geometric shapes.***

1. Bisect lines, arcs and angles.
2. Use drafting equipment to construct various lines.
3. Construct a circle and label its parts.
4. Construct various shapes using drafting equipment.

C. Simple Layout ..... 4 Hours

Outcome: ***Demonstrate simple layout procedures.***

1. List different methods of pattern development.
2. Develop a net pattern using simple layout.
3. Apply common duct connection allowances and notches.

4. Apply common duct fabrication allowances and notches.
5. Develop a gross pattern.

D. Rectangular Elbows ..... 6 Hours

Outcome: ***Develop patterns for flat, rectangular Heating, Ventilation and Air Conditioning (HVAC) elbows.***

1. List the considerations when planning an elbow.
2. Develop a net pattern for the cheek of a 90° elbow.
3. Develop a net pattern for the cheek of an elbow other than 90°.
4. Calculate the heel and throat stretch-out's.
5. Develop a gross pattern for a 90° elbow.
6. Create a cut list for a 90° elbow.

E. Rectangular Change Elbows / Y-Branches ..... 8 Hours

Outcome: ***Develop patterns for flat, rectangular (HVAC) change elbows. Develop patterns for flat rectangular Y-branches.***

1. List the considerations when planning a rectangular change elbow.
2. Develop a net pattern for the cheek of a 90° change elbow.
3. Develop a net pattern for the cheek of a rectangular change elbow other than 90°.
4. Calculate the heel and throat stretch-out's.
5. Create a cut list for a rectangular change elbow.
6. List considerations when planning a Y-branch.
7. Develop a pattern for a symmetrical Y-branch.
8. Determine stretch-out of throats and heels.
9. Describe the differences in development of non-symmetrical Y-branches.
10. Create a cut list for a Y-branch.

F. Ogee Offsets ..... 4 Hours

Outcome: ***Develop patterns for flat and rectangular ogee offsets.***

1. List considerations when planning an offsets.
2. Develop a net pattern for an ogee offset cheek.
3. State methods of determining wrapper stretch-out lengths.
4. Develop a net pattern for a change cheek ogee offset.
5. Develop a gross pattern for an offset.
6. Create a cut list for an ogee offset.

G. Duct Takeoffs ..... 2 Hours

Outcome: ***Develop patterns for flat, rectangular plenum takeoffs.***

1. Describe the considerations for a plenum or duct takeoff.
2. Develop a pattern for a sweep takeoff.

3. Develop a pattern for a rectangular plenum takeoff.
4. Develop a gross pattern complete with hammerlock.
5. Create a cut list for a rectangular plenum takeoff.

H. Introduction to Parallel Line Pattern Development ..... 2 Hours

Outcome: ***Demonstrate parallel line layout procedures.***

1. Identify the types of objects you can fabricate using the parallel line development method.
2. Define terms used in parallel line development.
3. Describe the principles of parallel line development.

I. Roof Jacks ..... 4 Hours

Outcome: ***Develop patterns for round and rectangular roof jacks.***

1. List terms and considerations for roof jack development.
2. Develop a complete set of net patterns for a roof jack with a single slope.
3. Describe the differences in procedure to develop patterns for a roof jack with more than one slope.

J. Finials ..... 2 Hours

Outcome: ***Develop patterns for simple finials.***

1. List the considerations for developing four sided finials.
2. Develop a net pattern for a four sided finial.
3. Develop a net pattern for a four sided finial when viewing the finial at 45°.
4. Develop a net pattern for a four sided finial with a radius.

K. Round Elbows and Offsets ..... 6 Hours

Outcome: ***Develop patterns for round elbows and offsets.***

1. List the considerations when planning round elbows and offsets.
2. Develop a net pattern for a 5 piece 90° round elbow.
3. Develop a pattern for an elbow other than 90°.
4. Calculate the mitre line of an offset using different methods.
5. Develop a gross pattern for a round offset.

L. Introduction to Conical Layout ..... 4 Hours

Outcome: ***Demonstrate conical layout procedures.***

1. Describe the principals of conical layout.
2. Develop a pattern for a conical object.
3. Develop a pattern for a conical rain cap.
4. Develop a pattern for a square rain cap.

SECTION THREE: ..... INTRODUCTION TO FABRICATION AND WELDING ..... 150 HOURS

A. Flat and Rectangular Fitting Fabrication ..... 78 Hours

Outcome: ***Fabricate and assemble flat rectangular (HVAC) fittings.***

1. Apply pattern development techniques to shop applications.
2. Describe how to form pieces for flat rectangular fittings.
3. Describe how to form duct connection joints.
4. Describe how to assemble various types of fittings.
5. Describe how to join duct fittings together.
6. Fabricate and assemble plenum takeoffs with common shop tools.
7. Fabricate and assemble rectangular duct reducers with common shop tools.
8. Fabricate and assemble regular or change tees or tap-in takeoffs c/w curved throats and heels with common shop tools.
9. Fabricate and assemble regular or change rectangular 90° elbows with common shop tools.
10. Fabricate and assemble rectangular regular or change Ybranch with common shop tools.
11. Fabricate and assemble regular or change rectangular offsets with ogee curves with common shop tools.
12. Fabricate and assemble sleeves (e.g. fire damper, wall sleeves) with common shop tools.
13. Fabricate and assemble rectangular and round flex connectors with common shop tools.
14. Assemble fittings to form specific duct lines.

B. Round Fitting Fabrication ..... 36 Hours

Outcome: ***Fabricate and assemble round elbows and offsets.***

1. Apply pattern development techniques to shop layout.
2. Describe seams used to fabricate round fittings.
3. Fabricate a round pipe include bead and crimp.
4. Fabricate a round elbow with spot welded lap seams.
5. Fabricate a round offset with spot welded lap seams.
6. Fabricate a round elbow seam.

C. Roof Jack Fabrication ..... 16 Hours

Outcome: ***Fabricate and assemble rectangular and cylindrical roof jacks.***

1. Describe fabrication considerations for different types of roof jacks.
2. Fabricate a round roof jack.
3. Fabricate a flat-sided roof jack.
4. Fabricate and attach a cap for a roof jack.

D. Joints and Seams ..... 2 Hours

Outcome: ***Fabricate and join various seams, edges and joints.***

1. Describe various lap seams.

2. Describe a grooved seam.
3. Describe flanged connection seams.
4. Describe machine formed seams.
5. Fabricate various lap seams.
6. Fabricate a grooved seam.
7. Fabricate flanged connection seams.
8. Fabricate machine formed seams.
9. Fabricate a field constructed slip joint.

E. Welding Safety ..... 4 Hours

Outcome: Follow safety procedures in welding.

1. Identify common hazards associated with welding.
2. State appropriate Personal Protective Equipment (PPE) used for welding.
3. Identify fire classes and fire prevention practices.
4. Identify oxy-acetylene outfit components and describe the safe care handling of the outfit.

F. Welding and Cutting Processes ..... 5 Hours

Outcome: Operate various welding processes used in Sheet Metal Work.

1. Describe various electric welding processes.
2. Describe the safe use of oxy acetylene (OAW) equipment.
3. Describe low temperature braze welding procedures.
4. Describe the safe use of equipment to cut metal.
5. Demonstrate the operation of a hand held plasma cutter.
6. Demonstrate the operation of a spot welder.

G. Mild Steel GMAW Welding ..... 9 Hours

Outcome: Weld mild steel using Gas Metal Arc Welding (GMAW).

1. Describe the GMAW process.
2. Set up and operate GMAW equipment.
3. Apply welding techniques to various weld joints.
4. Identify and troubleshoot weld faults.
5. Demonstrate the operation of GMAW equipment.
6. Demonstrate welding techniques of various weld joints.

SECTION FOUR: .....INTRODUCTION TO BLUEPRINT READING / RESIDENTIAL HVAC ..... 60 HOURS

A. Orthographic Projection ..... 10 Hours

Outcome: Draw sheet metal components using orthographic projection.

1. Identify orthographic type drawings.

2. Explain the method used to draw orthographic views.
3. Draw orthographic views from isometric drawings.
4. Construct orthographic drawings of sheet metal components.

B. Pictorial Drawings ..... 6 Hours

Outcome: ***Sketch related sheet metal components using various drawing techniques.***

1. Identify pictorial type drawings.
2. Explain the method used to draw pictorial type drawings.
3. Draw isometric drawings from orthographic projections.
4. Draw isometric drawings of sheet metal components.
5. Draw isometric drawings of sheet metal components.

C. Blueprint Reading Components ..... 4 Hours

Outcome: ***Interpret basic blueprint information.***

1. Use basic information found on a blueprint.
2. Interpret basic blueprints.
3. Identify common symbols used in blueprints and legends.
4. Identify abbreviations commonly used in blueprints.

D. HVAC Blueprints ..... 6 Hours

Outcome: ***Interpret basic (HVAC) information from a blueprint.***

1. Interpret supply air ducting from blueprint information.
2. Interpret return air ducting from blueprint information.
3. Interpret exhaust air from blueprint information.
4. Interpret HVAC equipment from blueprint information.
5. Interpret line schematics from blueprint information.

E. HVAC Material Takeoff ..... 10 Hours

Outcome: ***Develop a list of materials required to build and install an HVAC system from a blueprint.***

1. Describe the process for developing a material takeoff list.
2. Compile a list of equipment.
3. Compile a list of supply materials.
4. Compile a list of return air materials.
5. Compile a list of ventilation materials.
6. Develop a material takeoff list from a blueprint.

F. Residential HVAC Components ..... 7 Hours

Outcome: ***Describe components related to HVAC systems.***

1. Describe the supply air components of an HVAC system.

2. Describe the return air components of an HVAC system.
3. Describe the components of an under slab heating system.
4. Describe the components used to exhaust and support combustion.
5. Describe the components used to ventilate residential buildings.
6. Describe how system components effect air movement in low pressure duct designs.

G. Residential Heating Systems and Equipment ..... 7 Hours

Outcome: ***Install residential HVAC appliances, equipment and duct systems.***

1. Identify components of furnaces.
2. Identify accessories related to residential HVAC systems.
3. Describe residential distribution systems.
4. Describe residential combustion air and ventilation air systems.
5. Describe gas fireplaces.
6. Install various components related to low pressure duct systems.

H. Residential Installations and Codes ..... 10 Hours

Outcome: ***Apply residential heating codes and installation techniques.***

1. Identify various regulatory bodies.
2. Demonstrate an understanding of installation techniques to residential construction.
3. Demonstrate an understanding of installation codes and standards to residential construction.

SECOND PERIOD TECHNICAL TRAINING
SHEET METAL WORKER TRADE
COURSE OUTLINE

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

SECTION ONE:..... BASIC SHEET METAL THEORY..... 40 HOURS

A. Roofing .....4 Hours

Outcome: ***Apply weatherproofing techniques.***

1. Define various roofing terms.
2. Describe various materials used in roofing including their advantages and disadvantages.
3. Describe various seams and joints used in roofing.
4. Identify various types of flashings and components used in roof penetrations.
5. Describe procedures and precautions when performing roof penetrations.

B. Introduction to Combustion .....5 Hours

Outcome: ***Describe the principals of combustion, heat and temperature.***

1. Define various terms relating to combustion in gas appliances.
2. Describe how heat is produced and transferred.
3. Describe types of heat and units of heat measurement.
4. Describe various types of burners utilized in gas appliances.

C. Combustion Air Sizing .....7 Hours

Outcome: ***Demonstrate an understanding of current Gas Codes to size combustion air requirements.***

1. Determine combustion air supply for appliances located in tight construction enclosures.
2. Determine combustion air supply for appliances located in loose construction enclosures.

D. Appliance Venting .....10 Hours

Outcome: ***Apply current Gas Codes to size appliances and vents.***

1. Define various terms in appliance venting.
2. Describe different types of vents used on gas appliances.
3. Describe installation rules and procedures for various types of vents.
4. Describe minimum distances and Code requirements for the use of direct-vented appliances.
5. Describe various types of vents and flue dampers including operation and Code requirements.
6. Determine vent sizes using the appropriate Code.

E. Temperature, Humidity and Ventilation ..... 5 Hours

Outcome: ***Determine how temperature humidity and ventilation affect people, building structures and equipment.***

1. Define methods by which heat is transferred.
2. Define relative humidity and how it is measured.
3. Describe the effects of temperature and humidity on structures and personal comfort and list the methods of increasing or decreasing it.
4. Describe the ventilation air requirements for new residential construction.
5. Describe residential make-up air systems.

F. Air Filtration, Circulation and Noise ..... 5 Hours

Outcome: ***Determine how filtration, circulation and noise effects total comfort.***

1. Identify the different types of filters, their possible applications and how to maintain them to operate properly.
2. Identify how air circulation and noise can have an effect on comfort.
3. Identify and describe how filtration affects the human body.

G. Related Math Skills ..... 4 Hours

Outcome: ***Solve specialty trade related math problems.***

1. Use Pythagoras Theorem to solve problems related to slope and conical caps.
2. Solve problems using percentages and ratios.
3. Solve problems with bend allowance and mean diameter for various thicknesses of metal

SECTION TWO: ..... BASIC PATTERN DEVELOPMENT ..... 60 HOURS

A. Leaders Heads and Canopies ..... 4 Hours

Outcome: ***Develop patterns for leader heads and canopies using parallel line development.***

1. Identify the different applications for leader heads and canopies.
2. Develop net patterns for leader heads.
3. Develop net patterns for canopies.

B. Pipe Tees ..... 12 Hours

Outcome: ***Develop patterns for rectangular and round pipe tees on cylindrical bodies using parallel line development.***

1. Identify the various applications for pipe tees.
2. Develop net patterns for on centre round pipe tees.
3. Develop net patterns for off centre round pipe tees.
4. Develop net patterns for rectangular tees on round pipes.
5. Develop net patterns for 45° round pipe tees on centre.
6. Develop net patterns for 45° round pipe tees off centre.

7. Develop net patterns for 45° rectangular tees.

C. Introduction to Triangulation ..... 4 Hours

Outcome: ***Describe the theory of triangulation.***

1. Identify the various objects you can fabricate using triangulation.
2. Define the terms used in triangulation.
3. Identify the principals of triangulation.

D. Transitions and Twists ..... 6 Hours

Outcome: ***Develop patterns for transitions and twists.***

1. Identify various applications for transitions and twists.
2. Develop a pattern for an on centre rectangular duct transition.
3. Develop a pattern for an off centre rectangular duct transition.
4. Develop a pattern for a rectangular on centre 45° twist.
5. Develop a pattern for a rectangular off centre 45° twist.

E. Transitional Elbows ..... 8 Hours

Outcome: ***Develop patterns for transitional elbows.***

1. Identify the various applications for transitional elbows.
2. Develop net patterns for a 90° transitional elbow.

F. Transitional Ogee Offsets ..... 8 Hours

Outcome: ***Develop patterns for transitional ogee offsets.***

1. Identify the various applications for transitional ogee offsets.
2. Develop a net pattern for an FOB transitional ogee offset.
3. Develop a net pattern for a transitional ogee offset.

G. Transitional Y Branches ..... 6 Hours

Outcome: ***Develop patterns for transitional Y Branches.***

1. Identify the applications for transitional Y Branches.
2. Develop net patterns for transitional Y Branches parallel heel.
3. Develop net patterns for transitional Y Branches transitional heel.

H. Square and Rectangular to Round ..... 8 Hours

Outcome: ***Develop patterns for rectangular to round fittings using triangulation from plan view.***

1. Identify the applications for various square to round fittings.
2. Develop a net pattern for an on centre square to round.
3. Develop net patterns for a rectangular to round off centre one way.
4. Develop net patterns for a rectangular to round off centre two ways.

SECOND PERIOD

I. Round to Round Reducers ..... 4 Hours

Outcome: Develop patterns for round to round reducers.

1. Indentify the various applications for round to round reducers.
2. Develop a net pattern for a round to round reducer using radial line development.
3. Develop a net pattern for a round to round reducer using the angle transfer method.

SECTION THREE: .....BASIC FABRICATION ..... 120 HOURS

A. Transitional Fitting Fabrication ..... 57 Hours

Outcome: Fabricate and assemble transitional HVAC fittings.

1. Describe the differences to consider between transitional and non-transitional fittings.
2. Adjust a pattern to accommodate a duct connection.
3. Apply transitional fitting layout and fabrication techniques to develop and form curved wrapper fittings.
4. Apply transitional fitting layout and fabrication techniques to develop and form flat-sided transitional fittings.
5. Describe the process used to assemble transitional fittings.
6. Fabricate and assemble transitional fittings.

B. Conical Projects ..... 12 Hours

Outcome: Fabricate and assemble various conical projects.

1. Describe layout methods for conical development.
2. Fabricate a conical project.
3. Fabricate a wired edge on a conical project.
4. Describe the construction of various conical projects.

C. Custom Fabrication and Hand Skills ..... 21 Hours

Outcome: Fabricate and assemble various shaped custom projects.

1. Describe the considerations for custom projects.
2. Fabricate a double seam on a rectangular project.
3. Fabricate a wired edge on a rectangular project.
4. Fabricate a single or double seam on a round project.
5. Fabricate a wired edge on a round project.
6. Fabricate an elbow seam on a round project.
7. Fabricate a project using a welded seam.

D. Tee Fabrication ..... 20 Hours

Outcome: ***Fabricate and assemble cylindrical and rectangular pipe tees.***

1. Describe the process used to fabricate a 90° flat one side round pipe tee.
2. Describe the process used to fabricate a 45° round pipe tee on centre.
3. Fabricate and assemble a 90° flat one side round pipe tee.
4. Fabricate and assemble a 45° round pipe tee on centre.

E. Fabrication From Plan View ..... 3 Hours

Outcome: ***Fabricate and assemble sheet metal fittings developed using triangulation from plan view.***

1. Describe how to fabricate and assemble a rectangular to round fitting.
2. Fabricate and assemble a rectangular to round fitting.

F. Power Shop Equipment ..... 3 Hours

Outcome: ***Operate power shop equipment.***

1. Set up and safely operate a power shear.
2. Set up and safely operate a power brake.

G. Soldering ..... 4 Hours

Outcome: ***Demonstrate the ability to solder sheet metal projects.***

1. Describe soft soldering and its various applications in the sheet metal trade.
2. Describe the precautions associated with soldering.
3. Describe the soldering process including the required tools and equipment.
4. Solder various sheet metal projects.

SECTION FOUR: ..... BASIC BLUEPRINT READING ..... 40 HOURS

A. Multi Equipment Systems ..... 6 Hours

Outcome: ***Interpret residential and commercial multi equipment blueprints.***

1. Describe multi equipment systems.
2. Identify components of a multi equipment system.
3. Locate the components of a multi equipment system.

B. Multiple Family Blueprint Reading ..... 6 Hours

Outcome: ***Interpret multiple family blueprints.***

1. Identify multiple family structure types.
2. Describe special HVAC design considerations within multi family structures.
3. Identify equipment and distribution systems used in multi family structure.

C. Commercial Building Structures ..... 8 Hours

Outcome: ***Interpret commercial building construction types.***

1. Identify various construction styles.
2. Identify various building materials used in the structure.
3. Describe mechanical spaces within the structure.

D. Shop Drawings ..... 6 Hours

Outcome: ***Create shop drawing from field produced measurements.***

1. Produce itemized lists from a blueprint using a standard form.
2. Produce fabrication drawings from field measurements.

E. Light Commercial Installation Procedures ..... 8 Hours

Outcome: ***Develop light commercial installation procedures.***

1. Apply specifications to installation procedures.
2. Identify related trade concerns.
3. Locate building penetrations.
4. Describe the installation process.

F. Smoke and Fire Containment ..... 6 Hours

Outcome: ***Install fire dampers or fire stop flaps.***

1. Identify fire protection devices.
2. Describe installation requirements for fire protection devices.
3. Describe fire and smoke management.
4. Identify codes and regulations pertaining to smoke and fire containment devices.
5. Install fire dampers or fire stops flaps.

SECTION FIVE: ..... SYSTEM CONTROLS ..... 40 HOURS

A. Basic Electricity and Electrical Meters ..... 7 Hours

Outcome: ***Apply basic electrical theories to heating equipment.***

1. Explain electron flow.
2. Describe various electrical circuits.
3. Calculate Ohm's law.
4. Measure amps, volts and resistance.

B. Standard Furnace Components ..... 7 Hours

Outcome: ***Describe the components of a standard efficiency furnace.***

1. Describe how a furnace operates.
2. Describe gas train components.

3. Describe temperature sensing devices.
4. Describe furnace line voltage devices.
5. Describe combustion related components.

C. Basic Wiring Diagrams ..... 4 Hours

Outcome: ***Interpret wiring diagrams found in simple HVAC equipment or accessories.***

1. Interpret milli-volt wiring diagrams.
2. Interpret 24 volt wiring diagrams.
3. Interpret operation of equipment using diagrams.

D. Furnace Component Diagnostics and Installation ..... 6 Hours

Outcome: ***Diagnose and replace common types of furnace operational and safety controls.***

1. Diagnose and install gas train components.
2. Diagnose and install temperature sensing devices.
3. Diagnose and install line voltage devices.
4. Diagnose and install combustion related devices.

E. Basic Service ..... 8 Hours

Outcome: ***Service basic heating equipment and components.***

1. Perform basic furnace service.
2. Perform service on HVAC accessories.
3. Describe various applications for furnace line voltage equipment.

F. Heating with Alternative Fuels ..... 2 Hours

Outcome: ***Describe the operation of oil, solid fuel and electric heating equipment.***

1. Describe the operation of an oil furnace.
2. Describe the operation of a solid fuel furnace.
3. Describe the operation of an electric furnace.

G. Gas Piping ..... 6 Hours

Outcome: ***Thread, bend and flare gas piping. Apply installation codes to gas fired HVAC equipment.***

1. Describe black iron pipe and threading techniques.
2. Describe black malleable fittings and joining methods.
3. Describe copper pipe and joining methods.
4. Describe stainless steel flexible coated gas pipe.
5. Demonstrate threading, bending, joining and flaring of gas piping.
6. Describe installation codes found in the appropriate Gas Code.

THIRD PERIOD TECHNICAL TRAINING
SHEET METAL WORKER TRADE
COURSE OUTLINE

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

SECTION ONE: ..... INTERMEDIATE SHEET METAL THEORY ..... 40 HOURS

A. Stainless Steel ..... 4 Hours

Outcome: Describe how to select, weld and finish stainless steel.

1. Distinguish types of stainless steel and its applications.
2. Identify equipment, restrictions and capacities.
3. Describe fastening techniques.
4. Describe how to finish stainless steel.

B. Heat Loss and Heat Gain ..... 13 Hours

Outcome: Calculate heat loss and heat gain for a residence.

1. Describe heat transfer.
2. Describe methods of heat transfer.
3. Describe heat loss considerations
4. Describe heat loss calculations.
5. Apply heat loss calculation for a residence using spreadsheets.
6. Describe heat gain design considerations.

C. Residential HVAC Design ..... 12 Hours

Outcome: Design a residential duct system.

1. Select correct size and type of equipment to match load calculation.
2. Determine and design a basic residential air distribution system.
3. Solve problems of duct design using various related charts and duct calculators.

D. Air Flow ..... 6 Hours

Outcome: Interpret the characteristics of air flow and air movement.

1. Describe continuous air circulation and the proper adjustments necessary for cooling.
2. Describe common air flow testing instruments.
3. Describe common air flow terms and their relationship to air flow movement.
4. Describe various components of HVAC systems and their effects on air flow noise.

E. Small Commercial Duct Designs ..... 5 Hours

Outcome: ***Design a small commercial duct system.***

1. Select correct size and type of equipment.
2. Solve problems of duct design with a friction chart and ductulators.
3. Determine and design a small commercial air distribution system using SMACNA standards.

SECTION TWO: ..... INTERMEDIATE PATTERN DEVELOPMENT ..... 40 HOURS

A. Multiple Branches ..... 6 Hours

Outcome: ***Develop patterns for multiple branches.***

1. Identify various applications for multiple branch fittings.
2. Develop a net pattern for a three way branch using triangulation.

B. Triangulation From Elevation ..... 7 Hours

Outcome: ***Develop patterns for a square or rectangle to round on pitch, rectangle to round offset, rectangle to round 90° elbow and a garbage chute head using triangulation from elevation.***

1. Identify various applications for rectangle to round on pitch, rectangle to round offset, rectangle to round elbow and garbage chute head fittings.
2. Develop a net pattern for a rectangle to round on pitch using triangulation from elevation.
3. Develop a net pattern for a rectangle to round offset using triangulation from elevation.
4. Develop a net pattern for a rectangle to round 90° elbow using triangulation from elevation.
5. Develop a net pattern for a garbage chute head using triangulation from elevation.

C. Reducing Round Elbows ..... 6 Hours

Outcome: ***Develop patterns for reducing round elbows.***

1. Identify various applications for reducing round elbow fittings.
2. Develop a pattern for a reducing round three piece 90° elbow using triangulation.

D. Round Reducing Offsets ..... 4 Hours

Outcome: ***Develop patterns for reducing round offsets.***

1. Identify various applications for reducing round offsets.
2. Develop a net pattern for a tapering round offset using triangulation from elevation.

E. Round Reducing Y Branches ..... 8 Hours

Outcome: ***Develop patterns for round reducing Y Branches.***

1. Identify various applications for round reducing Y Branches.
2. Develop a net pattern for a round reducing Y Branch.

F. Truncated Cones ..... 2 Hours

Outcome: ***Develop patterns for a truncated cone using radial line development.***

1. Describe radial line pattern development for various cones including truncated cones.
2. Identify various applications for radial line layout.
3. Develop a net pattern for a truncated cone (roof jack on pitch) using radial line pattern development.
4. Develop a net pattern for the flashing of a roof jack on pitch using parallel line and simple layout.

G. Pipe Tees on Cones ..... 7 Hours

Outcome: ***Develop patterns for pipe tees on cones.***

1. Identify various applications for pipe tee on cone fittings.
2. Develop a net pattern for a vertical pipe tee on cone using radial line development.
3. Develop a net pattern for a horizontal pipe tee on cone using radial line development.
4. Develop a net pattern for a 45° pipe tee on cone using radial line development.

SECTION THREE: ..... INTERMEDIATE FABRICATION AND WELDING ..... 140 HOURS

A. Aluminum Fabrication ..... 12 Hours

Outcome: ***Apply aluminum fabrication techniques to construct an aluminum square to round project.***

1. Describe fabrication considerations when working with aluminum.
2. Develop a square or rectangle to round with a pitch base using aluminum with welded seams.

B. Stainless Steel Fabrication ..... 12 Hours

Outcome: ***Apply stainless steel fabrication techniques to construct a stainless steel project.***

1. Describe fabrication considerations when cutting and forming with stainless steel.
2. Develop and construct a project using stainless steel complete with welded GTAW joints.
3. Demonstrate buff and finish techniques on stainless steel project.

C. Medium Pressure Duct Fabrication ..... 52 Hours

Outcome: ***Fabricate a medium pressure duct line.***

1. Describe considerations incorporating Sheet Metal and Air Conditioning Contractors National Association (SMACNA) standards when fabricating fittings used in a medium pressure duct line.

2. Fabricate various fittings for a medium pressure duct line incorporating:
    a) rectangular elbow with turning vanes.
    b) rectangular to round transitions.
    c) various pipe tees.
    d) round tapering elbows.
    e) round pipe reducers
    f) round Y Branch.
    g) round tapering offset
    h) welded joints and seams.
3. Assemble a medium pressure duct.

D. Introduction to Computerized Layouts and Plasma ..... 12 Hours

Outcome: ***Describe how sheet metal fittings are developed using computer software and plasma cutting tables.***

1. Describe various types of computerized cutting equipment.
2. Describe the inputting of information for various duct fittings
3. Describe the operation of a plasma cutting machine, including safety practices.
4. Describe the finishing process of a fitting.
5. Demonstrate the procedure for completing a project cut on a plasma table.

E. SMACNA Specification Fabrication ..... 26 Hours

Outcome: ***Apply SMACNA fabrication specifications to construct HVAC components.***

1. Describe considerations incorporating SMACNA standards when fabricating rectangular roof ventilator (Goose Neck).
2. Fabricate an access door incorporating welding seams
3. Fabricate a louver.
4. Fabricate a rectangular roof ventilator.

F. Gas Tungsten Welding (GTAW) ..... 26 Hours

Outcome: ***Produce projects using GTAW welding equipment.***

1. Describe safety precautions associated with GTAW.
2. Set-up and operate the equipment for GTAW.
3. Produce GTAW welds on mild steel, aluminum and stainless steel.
4. Troubleshoot welding problems associated with GTAW.

SECTION FOUR:..... INTERMEDIATE BLUEPRINT READING ..... 40 HOURS

A. Multiple Zone Equipment ..... 8 Hours

Outcome: ***Identify multi zone equipment.***

1. Identify residential multi zone equipment.
2. Identify light commercial multi zone equipment.
3. Identify large commercial multi zone equipment.

B. Duct Construction ..... 9 Hours

Outcome: ***Apply SMACNA duct construction specifications to a large commercial blueprint.***

1. Describe how duct is classified according to velocity and pressure.
2. Describe the mechanical duct connections and common duct sealant procedures as they apply to different pressure classifications.
3. Describe and apply (SMACNA) standards for duct sizing, reinforcing joints and connections.

C. Specifications and Schedules ..... 5 Hours

Outcome: ***Interpret specification and material schedules.***

1. State the purpose of engineered specifications.
2. Describe the relationship between specifications and drawings.
3. Locate information from an engineered specification.
4. State the purpose of divisions within engineered specifications.
5. Identify strategies to complete a mechanical room from elevation and plan views.

D. Job Takeoffs ..... 8 Hours

Outcome: ***List all parts of a HVAC installation.***

1. Generate a complete material list from a residential HVAC print.
2. Generate a complete material list from a light commercial HVAC print.
3. Generate a complete material list from a large commercial HVAC print.

E. Job Supervision ..... 6 Hours

Outcome: ***Organize tasks related to large commercial projects.***

1. Identify the challenges of scheduling and coordinating.
2. Describe the procedure for ordering equipment and materials.
3. Identify the challenges of coordinating sub trades.

F. Architectural and Custom Sheet Metal ..... 4 Hours

Outcome: ***Interpret architectural and custom sheet metal components.***

1. Identify custom kitchen accessories.
2. Identify custom signage applications.
3. Identify custom HVAC applications including large mechanical rooms.
4. Identify decorative sheet metal applications.

SECTION FIVE: ..... INTERMEDIATE SYSYEMS CONTROLS ..... 40 HOURS

A. Electronic Ignition ..... 8 Hours

Outcome: ***Troubleshoot electronic ignitions and components found in HVAC equipment.***

1. Describe the operation of basic ignition systems used in mid and high-efficient furnaces.
2. Describe the application and sequence of operation of electronic controls.
3. Interpret electrical schematic drawings.
4. Describe diagnostic techniques and routine maintenance requirements for electrical controls.

B. System Controls and Schematics ..... 10 Hours

Outcome: ***Demonstrate an understanding of advanced types of operational and safety controls found in HVAC equipment.***

1. Describe control systems for cooling makeup air, air quality and ventilation.
2. Interpret electrical schematics used in furnace control systems.
3. Wire a furnace using advanced control circuits.

C. Furnace Start-up ..... 4 Hours

Outcome: ***Follow manufactures start-up procedures to complete a new furnace start-up.***

1. Perform basic start-up procedures following manufacturer's specifications of both mid and high efficient furnaces.
2. Verify proper operation of both mid and high efficient furnaces.

D. Testing and Troubleshooting ..... 12 Hours

Outcome: ***Use manufacture's sequence of operation manual to perform testing and troubleshooting procedures.***

1. Describe various instruments used for testing and troubleshooting HVAC equipment.
2. Describe annual fuel utilisation efficiency (AFUE).
3. Demonstrate the procedure for an appliance efficiency test.
4. Describe the procedure for diagnosing faults in a gas furnace.
5. Troubleshoot a non-functioning gas furnace.
6. Troubleshoot various safety interlock problems on both mid and high efficient furnaces.

E. Basic Refrigeration ..... 6 Hours

Outcome: ***Demonstrate an understanding of a basic refrigeration cycle.***

1. Describe the operation of a basic cooling system.
2. Identify the basic components of a cooling system.
3. List and describe refrigeration terms, common refrigerants and safety.
4. Describe how humidity levels can be controlled with dehumidifiers.

FOURTH PERIOD TECHNICAL TRAINING
SHEET METAL WORKER TRADE
COURSE OUTLINE

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

SECTION ONE: .....ADVANCED SHEET METAL THEORY ..... 40 HOURS

A. Natural Ventilation ..... 4 Hours

Outcome: ***Determine the causes and effects of natural ventilation on a building envelope.***

1. Describe the principles of natural ventilation.
2. Describe ventilation devices, openings and exhaust outlets.
3. Design ventilation techniques used in agricultural and industrial building designs.
4. Apply Alberta Building Code standards to attics and crawl spaces.

B. Energy Efficient Buildings ..... 4 Hours

Outcome: ***Analyze energy efficient building techniques and alternative heating devices.***

1. Describe high efficiency and alternate energy systems.
2. Describe various energy programs and agencies.
3. Describe construction techniques related to upgrading existing buildings.

C. Mechanical Air Movement and Control ..... 6 Hours

Outcome: ***Demonstrate a knowledge of various types of air handling devices.***

1. Describe various fan and blower terminology.
2. Identify various fan configurations and describe their characteristics.
3. Explain how to use fan performance graphs and curves.
4. Describe air controlling devices and their application.
5. Describe various dampers and their applications.

D. Commercial HVAC Systems ..... 6 Hours

Outcome: ***Recognize various HVAC systems.***

1. Describe the various types of heating and cooling systems.
2. Describe variable air volume systems and their components.
3. Describe constant volume systems and their components.
4. Describe make up air systems.

E. Commercial Air Filters and Sound Control ..... 5 Hours

Outcome: ***Select suitable methods for cleaning air and controlling noise.***

1. Describe sound attenuation and the methods used in reducing sound.
2. Describe materials used in sound attenuation and their application.
3. Describe the effects of sound attenuation on air flow.
4. Describe the purpose and types of various air filtering devices.
5. Describe air cleaning techniques and identify air cleaning equipment.
6. Describe the methods used to measure filter efficiency.

F. Industrial Exhaust ..... 5 Hours

Outcome: ***Determine requirements for removing or conveying various materials.***

1. Describe various collection and extractions systems.
2. Describe various material types and construction used in collection and extraction systems.
3. Describe industrial exhaust system standards.
4. Describe correct material conveying velocity.
5. Apply sizing techniques to complete a small collection system.

G. Commercial Kitchen Exhaust Systems ..... 6 Hours

Outcome: ***Design a commercial kitchen exhaust system.***

1. Describe the purpose and components of a commercial kitchen exhaust system.
2. Interpret applicable codes and regulations as they apply to designing and installing commercial kitchen systems.
3. Describe grease removal devices and their applications.
4. Size a grease filter for a commercial kitchen canopy.
5. Calculate make up air requirements for a commercial kitchen installation.
6. Choose proper equipment and components for a commercial kitchen exhaust system.

H. Trigonometry ..... 4 Hours

Outcome: ***Solve for angles and unknown parts of triangles by using trigonometry.***

1. Identify key terms and concepts used in working with triangles and trigonometry.
2. Identify special triangles and solve problems using related formulas.
3. Identify the Pythagorean Theorem and use it to solve problems.
4. Identify trigonometric formulas and solve problems using formulas.
5. Apply and calculate offsets and odd angle mitres using trigonometric functions.

SECTION TWO: ..... ADVANCED PATTERN DEVELOPMENT ..... 40 HOURS

A. Oblique Cylinders and Boot Tees ..... 8 Hours

Outcome: Develop patterns for oblique cylinder and boot tees.

1. Identify various applications for oblique cylinders and boot tees.
2. Develop a net pattern for right and oblique cylinders.
3. Develop a net pattern for an on centre boot tee using parallel line development.
4. Develop a net pattern for an off centre boot tee using parallel line development.

B. Boots ..... 10 Hours

Outcome: Develop patterns for boots on and off centre.

1. Identify various applications for end boots, right angle boots and top take offs.
2. Develop a net pattern for a top take off using triangulation.
3. Develop a net pattern for an on centre end boot using triangulation.
4. Develop a net pattern for an off centre end boot using triangulation.
5. Develop a net pattern for an on centre right angle boot using triangulation.
6. Develop a net pattern for an off centre right angle boot using triangulation.

C. Conical Tees ..... 4 Hours

Outcome: Develop patterns for conical tees on round pipe.

1. Identify various applications for conical tees intersecting round pipe.
2. Develop a net pattern for a conical 90° tee on round pipe using radial line development.
3. Develop a net pattern for a conical 60° tee on round pipe using radial line development.

D. Bull Head Tees ..... 8 Hours

Outcome: Develop patterns for bullhead tees.

1. Identify various applications for bullhead tee fittings.
2. Develop a net pattern for a bullhead tee fitting using triangulation.

E. Advanced Radial Lines ..... 8 Hours

Outcome: Develop patterns using advanced radial line development.

1. Develop a net pattern for an oblique cone using radial line development.
2. Develop a net pattern for an oblique 2 way Y Branch using radial line development.
3. Develop a net pattern for 3 way branch using radial line development.

F. Pattern Development Short Cuts ..... 2 Hours

Outcome: Develop various shortcut patterns.

1. Develop a net pattern for a square to round and a round to round reducer using rollation.
2. Develop a net pattern for a rectangular transitional elbow cheek using the slip technique.

3. Describe the techniques necessary to calculate a mitre in a job site.

SECTION THREE: .....ADVANCED FABRICATION AND WELDING..... 144 HOURS

A. Cladding and Lagging.....12 Hours

Outcome: ***Install cladding and lagging on an industrial piping system or vessel.***

1. Describe cladding and lagging material and select which material is best suited in a given installation.
2. Describe proper installation techniques.
3. Explain shortcuts used for developing patterns.
4. Using blueprints and specifications install cladding and lagging on an industrial piping mock up.

B. Advanced Shop Procedures.....70 Hours

Outcome: ***Fabricate advanced sheet metals projects.***

1. Demonstrate the knowledge required to fabricate advanced sheet metal projects.
2. Fabricate a multiple blade volume damper.
3. Fabricate various components from a dust and fume removal system.
4. Fabricate a low profile gravity roof ventilator.
5. Fabricate equipment plenums or equipment casings with 1 inch duct liner and perforated metal including an access doors in addition to the inlet and outlet.
6. Design and fabricate sheet metal projects demonstrating advanced sheet metal techniques.

C. Time Sensitive Fabrication.....53 Hours

Outcome: ***Fabricate sheet metal projects under time and material constraints.***

1. Layout patterns and fabricate a three to five piece elbow and square to round transition.
2. Layout patterns and fabricate a boot tee and round offset.
3. Layout patterns and fabricate an off centre rectangle to round with elbow.
4. Layout patterns and fabricate a transition Y branch with splitter.
5. Layout patterns and fabricate a Y round branch.
6. Fabricate an optional individual or group project.

D. Specialty GAS Metal Arc Welding (GMAW) Metal Inert Gas (MIG) Welding.....9 Hours

Outcome: ***Fabricate aluminum and stainless projects using GMAW (MIG) welding equipment.***

1. Describe safety precautions associated with GMAW (MIG) process.
2. Set-up and operate the equipment for GMAW (MIG) process.
3. Produce finished stainless steel welds using the GMAW (MIG) process.
4. Weld aluminum using the GMAW (MIG) process.

SECTION FOUR: ..... ADVANCED BLUEPRINT READING AND ESTIMATING..... 36 HOURS

A. Industrial Blueprints ..... 8 Hours

Outcome: ***Interpret industrial blueprints.***

1. Interpret industrial plant blueprints.
2. Interpret and identify industrial air handling equipment.
3. Interpret and identify industrial material handling equipment.

B. Estimating and Pricing ..... 10 Hours

Outcome: ***Develop a procedure to complete an HVAC bid.***

1. Compile a job take off given a commercial blueprint.
2. Identify the major categories of an estimate and apply them to a job take off.
3. Apply overhead (fixed and variable), labour costs and correction factors to a job take off.
4. Explain pricing strategies and their effect on the estimate.
5. Create a selling price and write a proposal.
6. Explain job costing and how it determines profit and loss.

C. Bidding Procedures ..... 8 Hours

Outcome: ***Describe the process to complete an HVAC bid.***

1. Identify the scope of the sheet metal trade.
2. Explain the process and methods used to tender projects.
3. Identify the purpose and goals of a commercial or industrial estimate.
4. Identify the possible problems associated with creating an estimate.
5. Explain various bonds associated with the sheet metal trade.

D. Workplace Coaching Skills ..... 4 Hours

Outcome: ***Display coaching skills.***

1. Describe coaching skills used for training apprentices.

E. Advisory Network ..... 2 Hours

Outcome: ***Describe the advisory network.***

1. Explain the role and purpose of the advisory network, local apprenticeship committee, and provincial apprenticeship committee.

F. Interprovincial Standards ..... 4 Hours

Outcome: ***Discuss Red Seal / Interprovincial standards***

1. Describe the National Occupational Analysis (NOA).
2. Describe the relationship between the NOA and Red Seal / Interprovincial examinations.
3. Discuss the roles of federal and provincial government in the development of Red Seal standards.
4. Discuss the role of industry in the development of Red Seal standards.

5. Explain the intent of the Red Seal exam as it relates to interprovincial mobility.
6. Describe sources of information on Red Seal standards and practice examinations.

SECTION FIVE: ..... ADVANCED SYSYEMS CONTROLS ..... 40 HOURS

A. Commercial HVAC Equipment ..... 8 Hours

Outcome: ***Interpret advanced types of operational and safety controls found in commercial HVAC equipment.***

1. Describe the function and operation of dual systems (combined heating cooling).
2. Describe the function and operation of make-up air units.
3. Describe the function and operation of heat pumps.
4. Describe the function and operation of Heat Recovery Ventilator (HRV) and Energy Recovery Ventilation (ERV) units.

B. Troubleshooting Commercial HVAC Equipment..... 10 Hours

Outcome: ***Use sequence of operation information to troubleshoot commercial HVAC equipment.***

1. Describe techniques used to start up, monitor the sequence of operation, and shut down commercial equipment and appliances.
2. Describe techniques used to take RPM readings on fan blowers and motors using a revolution counter and a strobotac.
3. Utilize wiring diagrams to trace two speed, multi-speed and variable speed motors, refrigeration circuits, package air handling equipment, make-up air and mid and high efficiency units.
4. Demonstrate techniques used to start up, monitor the sequence of operation, and shut down commercial equipment and appliances.
5. Demonstrate the ability to take RPM readings on fan blowers and motors using a revolution counter and a strobotac.

C. Spilt Systems ..... 13 Hours

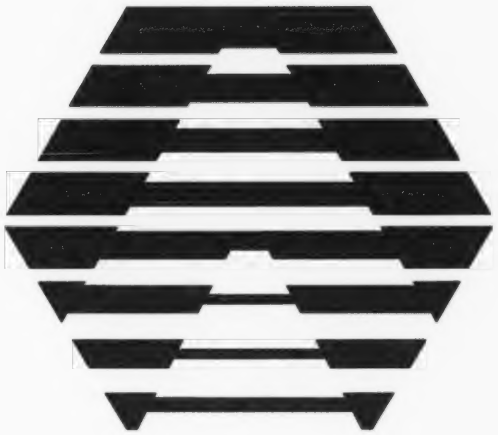
Outcome: ***Install and service air conditioning systems of 5 tons or less.***

1. Describe the specialty tools and equipment used.
2. Describe and perform proper method for piping connections and leak testing.
3. Describe and perform refrigerant recovery and evacuation process.
4. Describe and perform the proper charging and start up procedures for a cooling system.

D. Air Balancing..... 9 Hours

Outcome: ***Balance air flow in a HVAC system.***

1. Identify the instruments used for testing and balancing.
2. Measure the airflow on various outlets, grills and ductwork.
3. Describe the process for air balancing an HVAC system.
4. Balance a multi-outlet, single zone system using air balancing equipment.
5. Balance an HRV system.



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